UltraGrid Update

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Technology

- an affordable SW platform for very high-quality interactive video (up to 8K) and audio transmissions
- as low latency as possible on commodity hardware and reasonable networks
- use of commodity (gaming) hardware, laptops, even Raspberry Pi
  - Linux and Windows PC and Mac OS platforms
  - commodity video capture cards, webcams, Ximea cameras
  - commodity sound cards, USB sound cards (ASIO not officially supported)
  - commodity GPU cards
- uncompressed/compressed audio and video
- Any reasonable network
  - even a couple of Mbps ADSL can do /w lower quality
  - NAT support in development
    - Currently NAT can be traversed manually by fiddling with IP addresses/port assignment
    - Our goal is to have automated NAT traversal and STUN/TURN like solution built in

- Point-to-point and point-to-multipoint transmissions
  - basically a peer-to-peer model
  - a client-server model with central “MCU mixer” with “UltraGrid rooms” in development

- GUI

- Open-source software, BSD (GPL) license
  - https://www.ultragrid.cz/
  - https://github.com/CESNET/UltraGrid/

- User support, community
  - technical community growing on Github
  - ultragrid-dev@cesnet.cz
Development between UltraGrid 1.5 and 1.6
- 710 files changed, 69448 insertions(+), 39924 deletions(-)
- basic USB3 Ximea cameras support (the ones used by LoLa)
- native Windows 10 audio capture and playback support through the Windows WASAPI
- NDI video capture and playback support
- 10 and 12 bit video support, GoPro CineForm (SMPTE VC-5) video codec support and
tons of improvements towards accurate video processing and representation
- GUI improvements
- latest macOS versions support
Requests for distributed rehearsals started to pop out

Individual musicians/small bands
  - Totally limited equipment/possibilities

Home setups

UltraGrid + JackTrip (+ tpf-tools and packet reflector in UltraGrid)

We had some success with deployment even in home environments
  - Kudos to Jazzycats (a local jazz band)
  - Still requires someone technically savvy to deploy this

Limitations

- Network (18ms latency w/ 23ms jitter on my home DSL connection), bandwidth
  - A reasonable UG deployment requires at least 20Mbps
- NAT, Firewalls
- Home routers
What is Brewing?

- NAT support
  - Also thanks to a discussion at NowNet Arts
  - Unfortunately quite complex task

- Many types of NATs (Full cone, Restricted Cone, Port Restricted Cone)

- We have already basic techniques (UDP Hole Punching) in place

- UltraGrid can transit simple NAT implementations with manual fiddling with ports
  - Only one UltraGrid instance can be behind NAT

- What if bot UltraGrid instances are behind NAT
  - STUN server
  - TURN server
What is Brewing?

- **UltraGrid “server”**
  - UltraGrid basically operates on a peer-to-peer principle (multipoint with packet reflector is still based on that principle)
  - Users are more accommodated to client - server model

- **We already have a virtual room mode in the packet reflector**
  - Basically a MCU mixer (mixes incoming video streams into predefined layout)
  - “UltraGrid rooms”

- **We have already basic techniques (UDP Hole Punching) in place**
- **UltraGrid can transit simple NAT implementations with manual fiddling with ports**
  - Only one UltraGrid instance can be behind NAT

- **What if both UltraGrid instances are behind NAT**
  - STUN server
  - TURN server
Are there other options?

- **Everyone is using Zoom today**
  - 174,8 ± 1,0 ms* end-to-end audio latency (datacenter in Ireland)
  - even higher latency with original sound from microphone enabled, high-fidelity music mode and windows audio processing off 😞

- **eduMeet**
  - completely web browser, WebRTC based solution
  - 222,8 ± 8,5ms* end-to-end audio latency (on-premise deployment at CESNET)
  - 156,9 ± 1,3 ms* with AGC, AEC and noise suppression off

- **Digital-Stage**
  - [https://digital-stage.org/](https://digital-stage.org/)
  - multipoint audiovisual conferencing tool for art, music, theatre and ensembles
  - prototype in development
  - Windows, macOS and Linux application, web browser support (see eduMeet concerns)

  *Our own measurements, the SW evolves, results will probably vary for others*
Thank you for your attention!

Miloš Liška

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Using Ultragrid

Maria Isabel Gandía Carriedo

Advanced Networking Technology Overview
Network Performing Arts Production Virtual Workshop
27-04-2021
Background – From the Research and Education Networks, with Artists

- ePormundos Afeto (2011)
- Specifi (2014)
- Similarities (2017)
- I wish I would dance well under the stars (2019)
- A Short Journey into Folded Space (2019)
What do They Have in Common?
High Resolution
22 m\(^2\) screen \(\rightarrow\) 26 square yards
Using Network Technology to improve the Results
Using Network Technology to improve the Results: Jumbo Frames
Great Team

Reach the development team using email.

M. PULEC
J. MAREK
L. RUČKA
M. PIATKA
M. MINÁRIK
M. LIŠKA

Alumni
- Martin Beneš
- Lukáš Hejtmánek
- Petr Holub
- Martin Jirman
- Jiří Matela
- Dalibor Matura
- Ondřej Pavelka
- Ian Wesley-Smith
- Peter Stanko

http://www.ultragrid.cz/
Thank you!
And many thanks to the artists, the technicians and all the people that make these performances possible!

Questions?
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